UNIVERSITI SAINS MALAYSIA

Second Semester Examination
Academic Session 2007/2008

April 2008

EKC 107 – Organic Chemical Processes
[Proses Kimia Organik]

Duration : 3 hours
[Masa : 3 jam]

Please check that this examination paper consists of EIGHT pages of printed material before you begin the examination.

[Sila pastikan bahawa kertas peperiksaan ini mengandungi LAPAN muka surat yang bercetak sebelum anda memulakan peperiksaan ini.]

Instructions: Answer **FOUR** (4) questions. Answer **TWO** (2) questions from Section A. Answer **TWO** (2) questions from Section B.

*[**Arahan:** Jawab **EMPAT** (4) soalan. Jawab **DUA** (2) soalan dari Bahagian A. Jawab **DUA** (2) soalan dari Bahagian B.]*

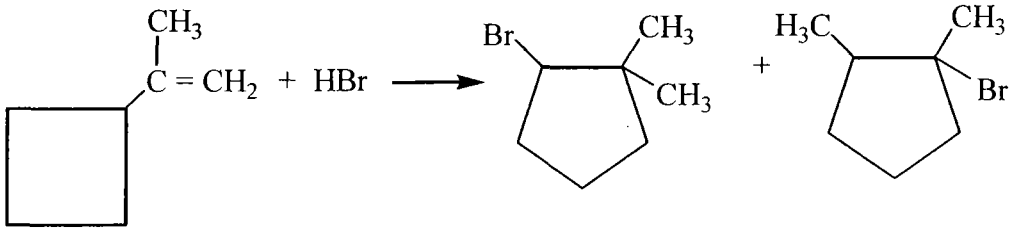
You may answer your questions either in Bahasa Malaysia or in English.

[Anda dibenarkan menjawab soalan sama ada dalam Bahasa Malaysia atau Bahasa Inggeris.]

Section A : Answer any TWO questions.
Bahagian A : Jawab mana-mana DUA soalan.

1. [a] Propose a mechanism for the following reaction:

Cadangkan satu mekanisma untuk tindakbalas berikut:



[6 marks/markah]

[b] Catalytic cracking of $C_{19}H_{40}$ was carried out using a zeolite catalyst. Answer the following questions.

Peretakan bermangkin bagi $C_{19}H_{40}$ telah dijalankan dengan menggunakan mangkin zeolit. Jawab soalan berikut.

[i] Give the two methods which will generate $+C_{19}H_{39}$ carbocations. Give the corresponding equations associated with the production of $+C_{19}H_{39}$.

Berikan dua kaedah untuk menghasilkan karbokation $+C_{19}H_{39}$. Berikan persamaan-persamaan yang berkaitan dengan penghasilan $+C_{19}H_{39}$.

[2 marks/markah]

[ii] Using $C_{19}H_{40}$ as an example, what type of carbocations will be formed when reacted with R^+ ion (generated by the two methods above)? Give two reasons for your answer.

Gunakan $C_{19}H_{40}$ sebagai contoh. Apakah jenis karbokation-karbokation yang akan terbentuk apabila ditindakbalaskan dengan ion R^+ (yang dihasilkan daripada dua kaedah di atas)? Berikan dua sebab sebagai jawapan anda.

[4 marks/markah]

[iii] Give two characteristics of the carbocations. Show one example for each characteristics.

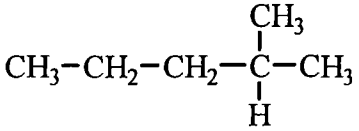
Berikan dua ciri untuk karbokation- karbokation. Tunjukkan satu contoh untuk setiap ciri tersebut.

[4 marks/markah]

[iv] Propose mechanisms for the formation of these compounds:-

Cadangkan mekanisma-mekanisma untuk pembentukan sebatian-sebatian berikut:-

(a) $CH_3\,CH_2\,CH_2\,CH_2\,CH_2\,CH_2 = CH_2$

(b) 

[5 marks/markah]

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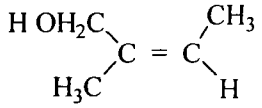
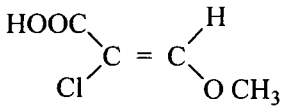
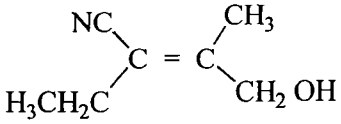
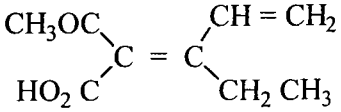
[c] Assign E or Z configuration to each of the following alkenes:
Berikan konfigurasi E atau Z kepada setiap alkena di bawah:

[a] 

[b] 

[c] 

[d] 

[4 marks/markah]

2. [a] List five features of processes which tend to increase capital cost. Explain briefly on one of the features.
Senaraikan lima ciri yang akan menaikkan kos kapital bagi sesuatu proses. Terangkan secara ringkas salah satu daripada ciri-ciri tersebut.

[6 marks/markah]

[b] When 2-methylpropane is monochlorinated in the presence of light at 25°C, 36% of the product is 2-chloro-2-methylpropane and 64% is 1-chloro-2-methylpropane. From these data, calculate how much easier it is to abstract a hydrogen atom from a tertiary carbon than from a primary carbon under these conditions.
Apabila 2-metilpropana melalui tindakbalas pengklorinanmono di dalam kehadiran cahaya pada 25°C, 36% daripada produknya ialah 2-kloro-2-metilpropana dan 64% ialah 1-kloro-2-metilpropana. Melalui data ini, kirakan bagaimana mudahnya untuk mengabstrak atom hidrogen daripada karbon tertier berbanding dengan karbon primer dalam keadaan ini.

[5 marks/markah]

[c] If 2-methylpropane is brominated at 25°C in the presence of light, what percent of the product will be 2-bromo-2-methylpropane? Compare your answer with the percent given in Question 2. [b] for chlorination. What can you deduce from these results?
Sekiranya 2-metilpropana melalui tindakbalas pengbrominan pada 25°C dengan kehadiran cahaya, apakah peratusan produknya adalah 2-bromo-2-metilpropana? Bandingkan jawapan anda dengan peratusan yang diberikan dalan Soalan 2.[b] untuk tindakbalas pengklorinan. Apakah yang boleh anda rumuskan daripada keputusan-keputusan ini?

(Given the relative rate of radical formation by a bromine radical at 25°C)
(Kadar relatif bagi pembentukan radikal oleh radikal bromin pada 25°C)

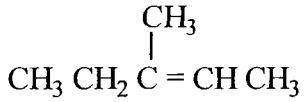
tertiary >	secondary >	primary
tertier >	*sekunder* >	*primer*
1600	82	1

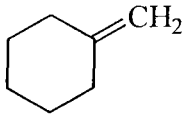
[5 marks/markah]

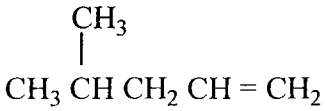
...4/-

[d] Alkenes can be converted into alcohols by acid-catalyzed addition of water. Predict the major alcohol products from each of the following alkenes.

Alkena boleh ditukarkan ke alkohol melalui penambahan air dengan mangkin berasid. Ramalkan produk alkohol utama yang akan terbentuk daripada alkena-alkena berikut.

[i] 

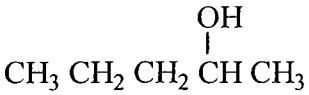
[ii] 

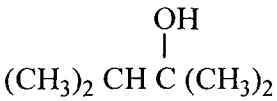
[iii] 

[3 marks/markah]

[e] Which of the following alcohol could not be made selectively by hydroboration/oxidation of an alkene? Explain.

Alkohol yang mana satukah di antara berikut yang tidak boleh dihasilkan secara selektif melalui tindakbalas hidroboroksi/pengoksidaan alkena? Terangkan.

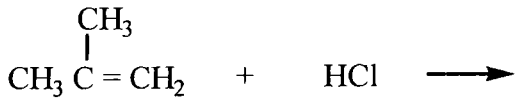
[a] 

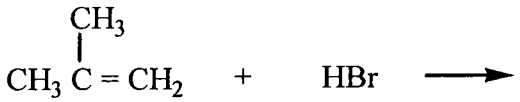
[b] 

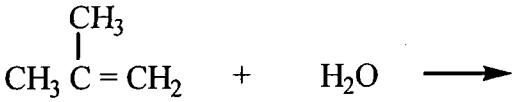
[6 marks/markah]

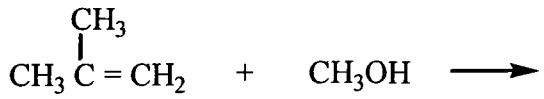
3. [a] Give the major product of each of the following reactions:

Berikan produk utama untuk setiap tindakbalas yang berikut:

[i] 

[ii] 

[iii] 

[iv] 

[4 marks/markah]

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[b] What do all the reactions have in common?
Apakah persamaan bagi tindakbalas-tindakbalas di atas?

[4 marks/markah]

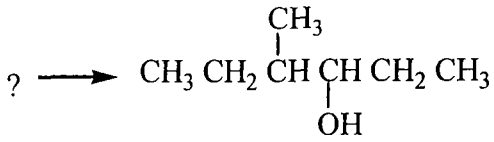
[c] How do all the reactions differ? Explain.
Bagaimanakah tindakbalas-tindakbalas di atas berlainan antara satu sama lain. Terangkan.

[4 marks/markah]

[d] Show the mechanism for reactions in [iii] and [iv].
Tunjukkan mekanisma untuk tindakbalas [iii] dan [iv].

[4 marks/markah]

[e] How can you prepare the following alcohol?
Bagaimanakah caranya untuk menyediakan alkohol berikut?



[4 marks/markah]

[f] The product of the addition of Br_2 to 3-methyl-1-butane is 1,2-dibromo-3-methylbutane. What would have been the product of the above reaction if HBr had been used as a reagent instead of Br_2? Explain.
Produk yang terhasil daripada tindakbalas penambahan Br_2 kepada 3-metil-1-butana ialah 1,2-dibromo-3-metilbutana. Apakah produk yang akan terhasil daripada tindakbalas di atas sekiranya HBr digunakan sebagai reagen menggantikan Br_2? Terangkan.

[5 marks/markah]

Sections B : Answer any TWO questions.
Bahagian B : Jawab mana-mana DUA soalan.

4. [a] Write equations showing how to prepare 4-*tert*-butyl-2-nitrotoluene from toluene and any necessary organic or inorganic reagents. If an ortho and para mixture is formed in any step of your synthesis, assume that you can separate the two isomers.
Tuliskan persamaan-persamaan yang menunjukkan bagaimana anda boleh menyediakan 4-tert-butil-2-nitrotoluena daripada toluena dan sebarang bahan organik atau tak organik. Jika sesuatu campuran orto dan para terbentuk dalam mana-mana langkah sintesis, andaikan yang anda boleh memisahkan kedua-dua isomer tersebut.

[4 marks/markah]

[b] Give the product of acylation of naphtalene with CH_3COCl and $AlCl_3$ in the solvent

Berikan produk pengasilan naftalena dengan CH_3COCl dan $AlCl_3$ dalam pelarut

[i] CS_2 [ii] $PhNO_2$

[4 marks/markah]

[c] Explain the different products in [b]

Terangkan produk-produk yang berbeza dalam [b]

[2 marks/markah]

[d] Provide the product(s) of the reaction of naphthalene with succinic anyhydride and $AlCl_3$ in $PhNO_2$.

Berikan produk-produk tindakbalas naftalena dengan suksinik anhidrida dan $AlCl_3$ dalam $PhNO_2$.

[5 marks/markah]

[e] Define the following terms and give one example each of them

Takrifkan terma-terma berikut dan berikan satu contoh bagi setiap satu

[i] Homopolymer
Homopolimer

[ii] Copolymer
Kopolimer

[4 marks/markah]

[f] What is vulcanization?

Apakah pemvulkanan?

[6 marks/markah]

5. [a] Classify the following substitutent in the following categories: ortho, para and very strongly activating (VSA), strongly activating (SA), activating (A) and deactivating (D); meta and strongly deactivating (SD) and very strongly deactivating (VSA)

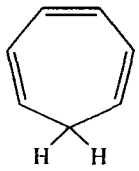
Kelaskan bahan ganti-bahan ganti di bawah menurut kategori-kategori yang berikut: orto, para dan pengaktif sangat kuat (VSA), pengaktif kuat (SA), pengaktif (A) dan penyahaktif (D); meta dan penyahaktif kuat (SD) dan penyahaktif sangat kuat (VSA)

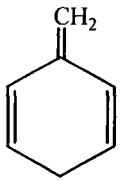
[i] - OH
[ii] - NO_2
[iii] - Br
[iv] - OR
[v] - R
[vi] - SO_3H

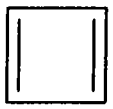
[6 marks/markah]

[b] Classify the following compounds as aromatic, antiaromatic and not aromatic? If they are not aromatic, explain why.

Kelaskan sebatian-sebatian yang berikut sebagai aromatik, antiaromatik dan tak aromatik. Jika sebatian adalah tak aromatik, jelaskan kenapa.

[i] 

[ii] 

[iii] 

[6 marks/markah]

[c] Draw the structures of all the following:

Lukis struktur-struktur untuk kesemua yang berikut:

[i] dibrominated derivatives of C_6H_6 and
terbitan dibrominat C_6H_6

[ii] tribrominated derivatives of C_6H_6.
tertibatan tribrominat C_6H_6.

[6 marks/markah]

[d] What is catalytic reforming? Explain the process.

Apakah pembentukan semula bermangkin? Terangkan proses tersebut

[7 marks/markah]

6. [a] Show the formation of the electrophile in the following reactions and identify each base.

Tunjukkan pembentukan elektrofil dan kenalpastikan bes bagi setiap tindakbalas berikut.

[i] $Cl_2 + AlCl_3$
[ii] $HNO_3 + H_2SO_4$
[iii] $Br_2 + Fe$
[iv] H_2SO_4

[6 marks/markah]

[b] Compare the Friedel-Crafts alkylation with RX and acylation with RCOX as to the

Bandingkan pengalkilan Friedel-Crafts dengan RX dan pengasilan dengan RCOX dari sudut

[i] mechanism and
mekanisma dan

[ii] kind of catalyst
jenis mangkin

[6 marks/markah]

[c] Show by an arrow the preferred product of reaction with E^+ of each of the three isomeric methoxytoluene and explain your choices.

Tunjukkan dengan anak panah setiap produk terpilih bagi ketiga-tiga tindakbalas metoksitoluena isomer dengan E^+ dan terangkan pilihan anda.

[6 marks/markah]

[d] What is inorganic detergent builders? Classify the main groups of inorganic builders?

Apakah pembina bahan cuci inorganik? Kelaskan kumpulan-kumpulan utama pembina organik?

[7 marks/markah]

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